Headquarters U.S. Air Force

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USAF Weather Overview and Plans

Jeff Cetola
ACC/A5W (Tech Director, Weather Requirements)
JCSDA Workshop - 17 May 2017

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Overview

- Air Force Weather Capability Development & Organizational Structure
- Air Force Weather Analysis & Prediction Requirements
- Cloud Analysis & Forecasting
- Land Surface Characterization
- Data Assimilation Focus Areas
- Data Assimilation Objectives

AFW Capability Development and Organizational Structure

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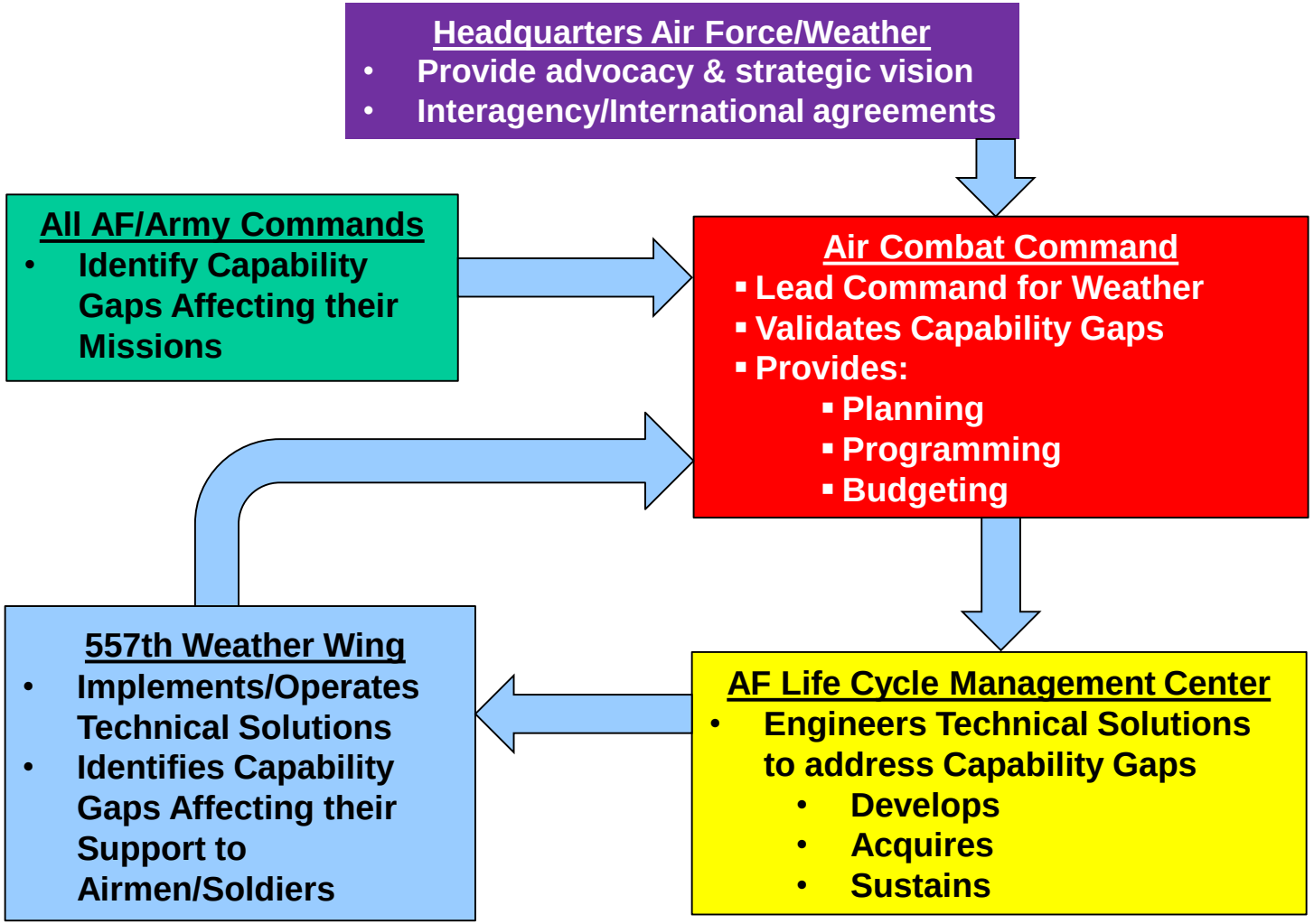

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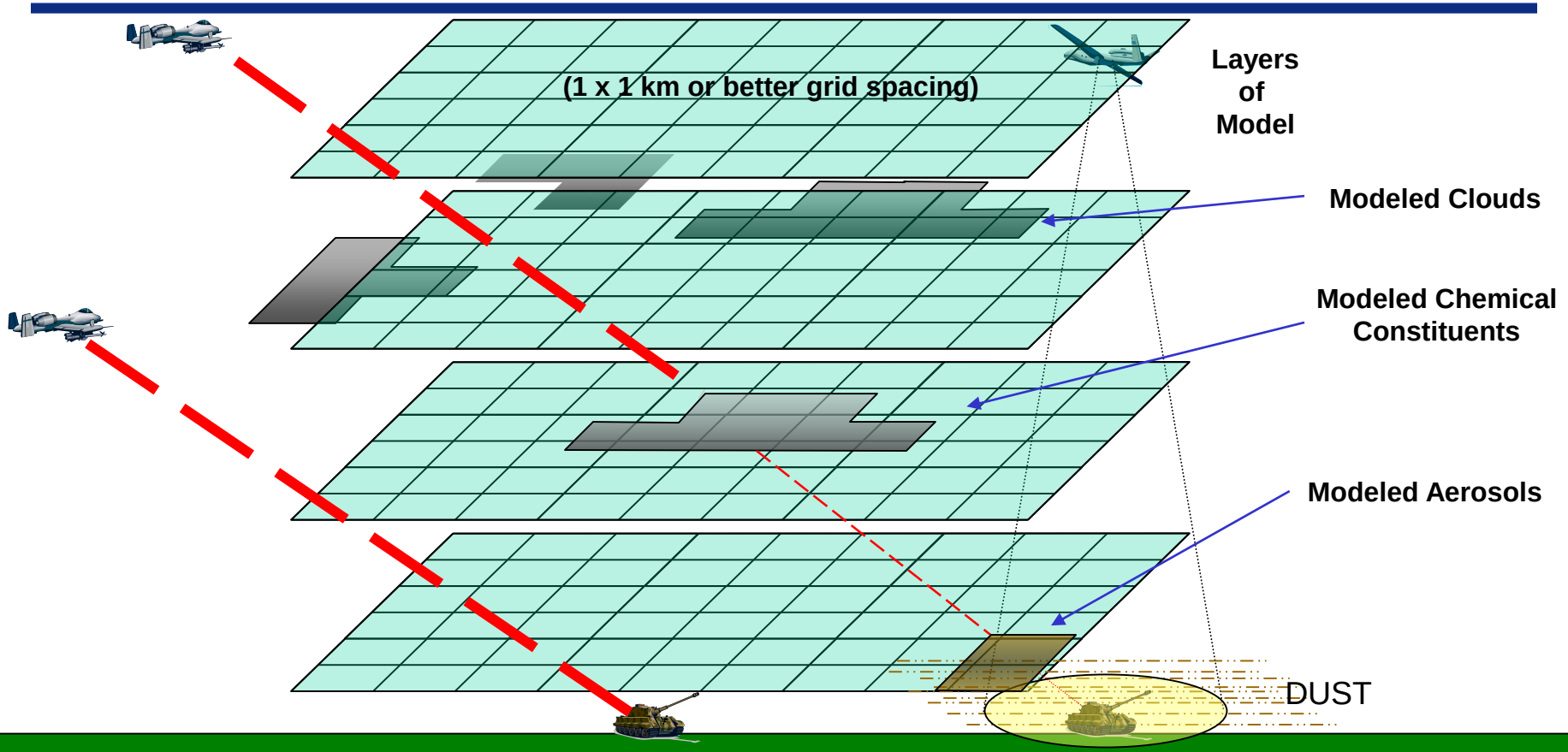
AFW Requirements

High Fidelity Clouds & Aerosols are the Driving Requirements



- Spatial resolution: Horizontal: 1 x 1 km, Vertical: 100m (SFC 5000') 1km above
- Temporal resolution: 1hr steps for 0-24hrs, 3hr steps for 12-72hrs, 6hr steps for 72-240hrs
- Quantify aerosol/cloud "amount" on 1km grid for each layer of model
- Predict slant path (visible/IR) detection by integrating layered cloud/aerosol forecasts
- For visual acquisition, output defaults clear line of sight that accounts for aerosols as well as clouds.
- For IR acquisition, output chemical constituent dependencies per sensor type, target temp, background temp, etc. in addition to slant path clouds, aerosols.

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Global Cloud Analysis & Forecasts

- Clouds are a primary analysis and forecast focus for USAF due to impacts on:
  - Intelligence, Surveillance, and Reconnaissance Operations
  - Aviation Flight Operations
  - Sensible Weather
- Analysis currently addressed with World-Wide Merged Cloud Analysis (WWMCA)
  - Hourly Analysis stitching together visible and IR measurements from multiple satellites
- Forecast currently addressed with:
  - Advect Cloud (ADVCLD) – short-term (0-12 hrs) advective technique using WWMCA
  - Discriminative Cloud Forecast (DCF) – longer term (to 120 hrs) regression-based technique

World-Wide Merged Cloud Analysis & Cloud Diagnostic Forecast System

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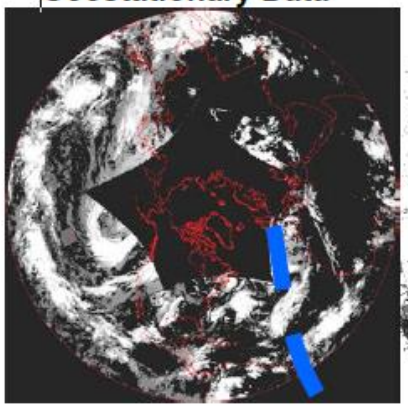
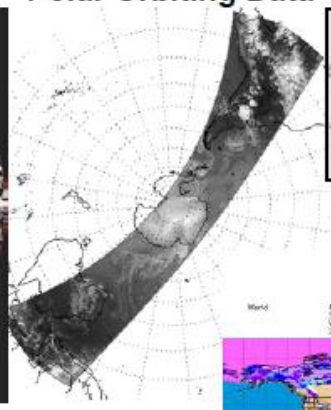
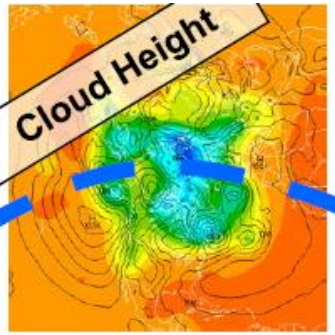
Geostationary Data



Polar Orbiting Data

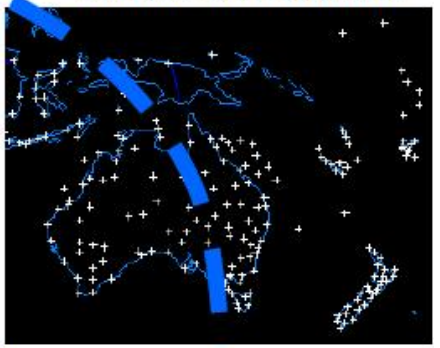


- DMSP
- AVHRR
- MODIS
- VIIRS



GFS
Upper Atmos. Temp
Near Surface Temp/RH/Wind

Surface Observations

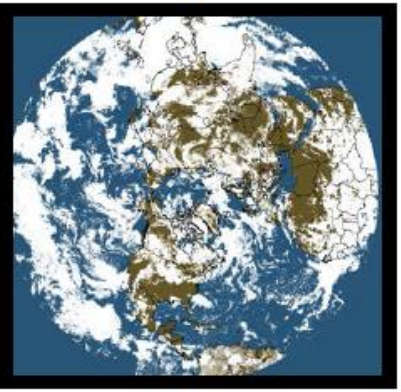


Snow Analysis
Resolution: 12 nm
Obs: Surface, SSM/I
Freq: Daily, 12Z

Surface Temp Analysis
Resolution: 12 nm
Obs: IR imagery, SSM/I Temp
Freq: 3 Hourly

World-Wide Merged Cloud Analysis (WWMCA)
Hourly, global, real-time, cloud analysis @12 nm

Total Cloud **and** ***Layer Cloud*** **data supports National Intelligence Community, cloud forecast models, and global soil temperature and moisture analysis.**



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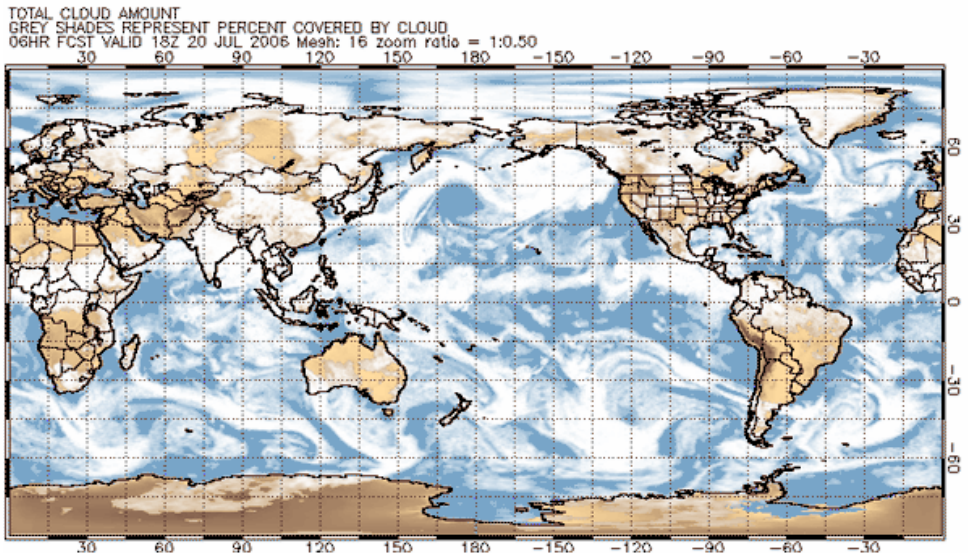
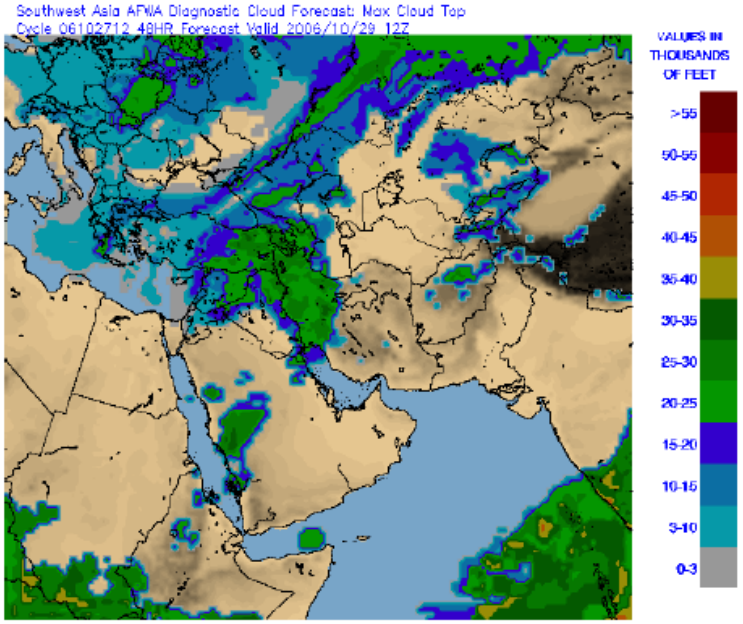
Cloud Forecast Models





Short Range Cloud Forecast:

- Primary for hours 1 – 6
- 24 km resolution
- Total fractional cloud coverage
- Layer coverage (5-layers)

Diagnostic Cloud Forecast:

- Primary beyond 6 hours
- Down to 5 km resolution
- Total fractional cloud coverage
- Layer coverage (5-layers)

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Global Cloud Analysis & Forecasts: Goals

- Near-term goal is to maintain legacy capability with some incremental improvements (e.g. additional IR channels) and NWP-based short-term cloud forecast prototype verification
- Long-term goal is to integrate cloud analysis and forecasting into the NWP data assimilation prediction process to result in:
  - Enhanced 3-D depiction of clouds
  - Cloud data consistent with other meteorological variables
  - Enhanced sensible weather forecasts
  - High Resolution/Rapid Refresh
- Research Issues:
  - Assimilation of clouds into NWP
  - Ensure dynamic consistency with assimilated clouds
  - Sufficient cloud microphysics within models
  - Validation Data

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Global Land Surface Characterization

- Important due to impact on:
  - Numerical Weather Prediction
  - Ground forces operations/Trafficability
  - Sensible weather prediction
  - Crop assessments
- Current capability
  - NASA Land Information System (LIS)
    - Noah, Noah-MP, and JULES LSMs
- Goals
  - Increased Data Assimilation Sources
  - Higher resolution
  - Higher accuracy
  - Model Coupling/Unified Data Assimilation

Recent Land Surface Characterization Data Assimilation Improvements*

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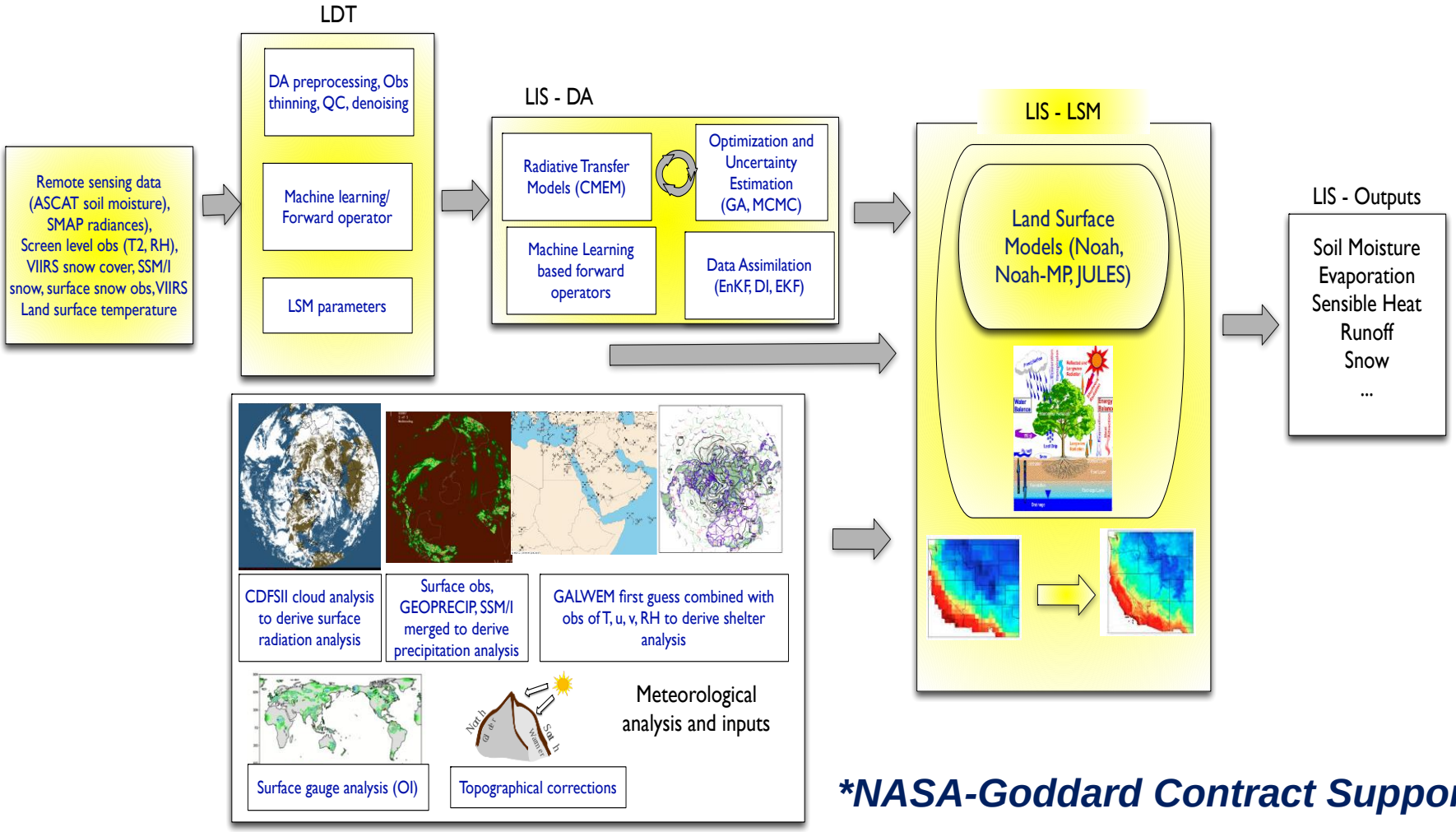

*NASA-Goddard Contract Support

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Data Assimilation Focus Areas

- Primary focus areas for USAF are:
  - Global capability
  - Clouds
  - Aerosols/Chemical Constituents
  - Land Characterization
  - Non-traditional Observations
  - Numerical Weather Prediction, to include rapid refresh
- AFW desires to have a fully integrated DA/NWP system for Clouds, Aerosol & Chemical constituents Land Characterization, and Sensible Wx (mid 2020s)
- AFW has relied and will continue to rely on operational and research partners to pursue these focus areas as well as overall DA/NWP development

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Data Assimilation Objectives

- **Model agnostic capability – as much as technically feasible; provide maximum flexibility**
- **Support/enable hourly cloud analysis & provide for assimilation of cloud (all-sky) parameters into NWP model**
- **Provide for the analysis & forecast of aerosols**
- **Incorporate state-of-the-art Land Surface Characterization & Model**
- **Enable a unified, coupled data assimilation**
- **As much as is feasible, actively participate in JCSDA-lead Joint Effort for Data assimilation Integration (JEDI) project**

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Questions?

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